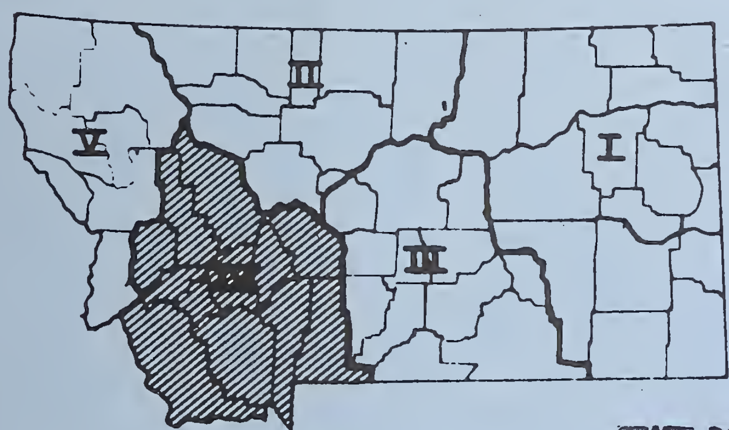
REGION FOUR

SOLID WASTE FACILITY PLAN



STATE OF MONTANA
SOLID WASTE MANAGEMENT
AND
RESOURCE RECOVERY STUDY

AUGUST, 1976

HENNINGSON, DURHAM & RICHARDSON

ENGINEERING • ARCHITECTURE • PLANNING • SYSTEMS • ECONOMICS

HELENA, MONTANA

ATLANTA · CHARLOTTE · CHICAGO · DALLAS · DENVER · LOS ANGELES · MINNEAPOLIS · NEW ORLEANS · NORFOLK, VA
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A. INTRODUCTION

The purpose of this report is to give the state, county and local officials and the citizens of Montana a brief synopsis of the status of the on-going Montana Solid Waste Management and Resource Recovery Study. The project was initiated in June, 1975, and it is anticipated that the project will be completed in December, 1976. The consulting engineering firm of Henningson, Durham & Richardson was retained by the Montana Department of Health and Environmental Sciences to assist them on the project. In addition to state funds, financial assistance was provided by the Environmental Protection Agency (EPA).

The primary objective of this study is to determine the possibility of utilizing the combustible fraction of solid waste as an energy source and to also determine the possibility of recovering secondary materials found in the State's solid waste stream. Also included in the scope of work is the development of solid waste management plans for each of the five state planning regions. These management plans will indicate which available solid waste disposal method or methods is most economically viable and environmentally acceptable throughout the state.

B. SUMMARY OF INFORMATION PUBLISHED TO DATE

To date, three major reports have been prepared by the Consultant. Copies of the three reports are available upon request from the Montana Department of Environmental Sciences, Solid Waste Management Bureau. The three reports summarize the following investigations: (1) the quantity and composition of solid waste generated throughout the State ("Population, Employment and Waste Generation Report"); (2) the potential markets for recoverable materials found in the solid waste generated in the State ("Energy and Secondary Materials Market Report"); and (3) the technical and operating requirements and costs for various solid waste processing, utilization and disposal alternatives applicable in the State ("Alternative Disposal and Materials Recovery Technology Report"). Included in the following is a summary of the information in the three reports.

1. Solid Waste Generation.

To determine the quantity and composition of waste generated in the State, detailed investigations were conducted at ten waste disposal sites. Based on the surveillances, average waste generation rates were developed for various population sizes. The generation rates are summarized below:

City Population	Waste Generation Rate (pounds/person/day)
Greater than 5,000	5.70
1,000 - 5,000	3.25
Less than 1,000*	2.25

*includes rural population

From the generation rates, it was determined that approximately 590,000 tons of solid waste is generated in the State annually. This represents an average waste generation rate of 4.28 pounds per person per day. The quantity of waste is projected to increase approximately 36 percent by 1990, to 870,000 tons per year.

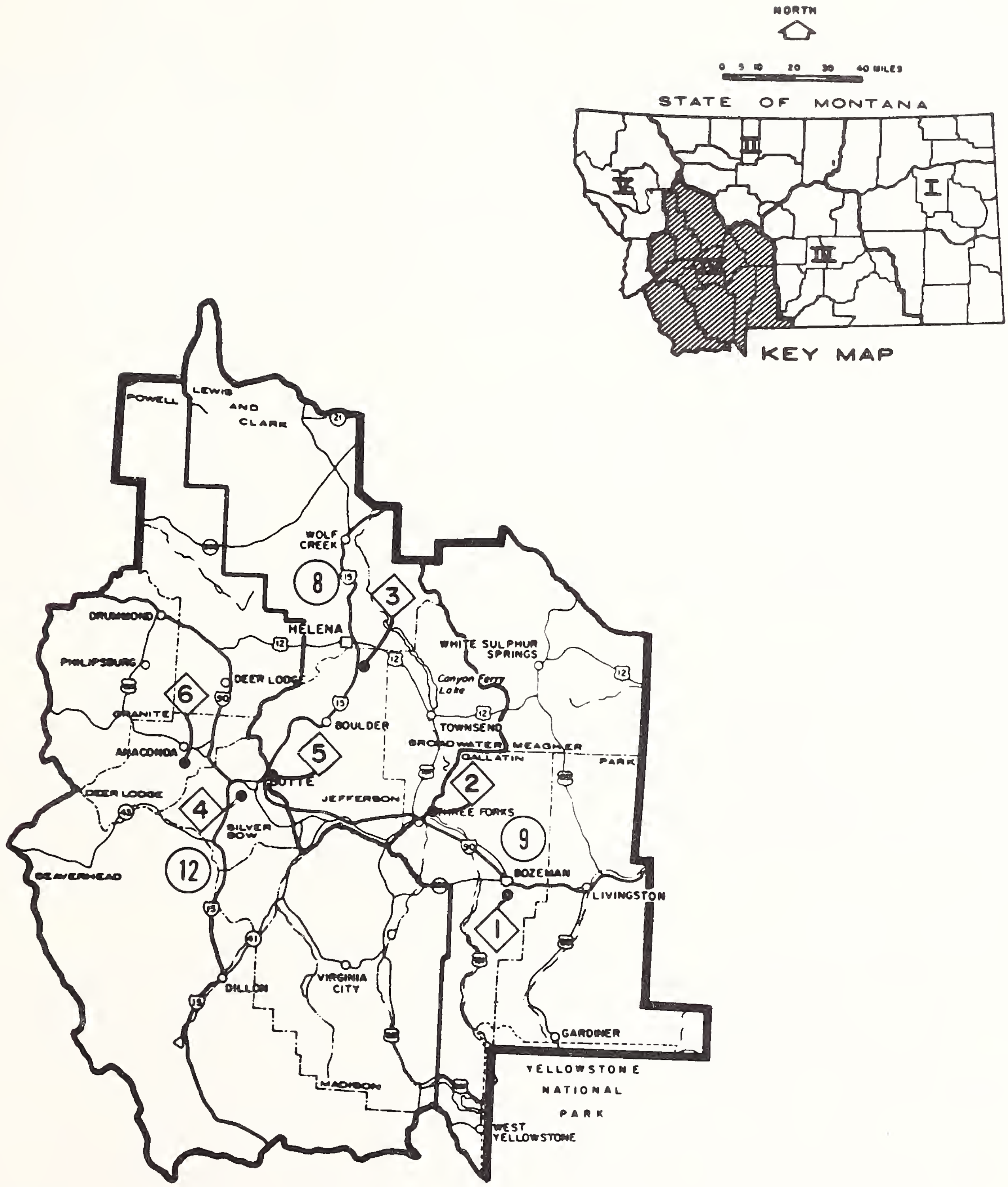
To determine the general combustible characteristics of solid waste generated within the State, fifty random samples of solid waste were collected and sent to a commercial laboratory for analysis. The results indicated that the average heat value is approximately 5,000 Btu/pound on an as-received basis. In comparison, this represents approximately two-thirds of the heat value of Montana coal on an equivalent Btu basis.

2. Markets for Recoverable Materials.

There are two types of recoverable materials found in processable solid waste: (1) materials which can be used as a fuel to generate steam, electricity and/or heat and (2) secondary materials which can be reused. The fuel fraction consists predominantly of the mixed combustible fraction of the solid waste stream. Recoverable secondary materials consist predominantly of ferrous and non-ferrous metals, separated newsprint and corrugated paper and glass.

To identify potential users of processed solid waste as an energy source, several methods were employed to obtain information regarding the State's present and future energy users. These included questionnaires to large industrial consumers of energy, interviews with the various fuel suppliers in the State and on-site interviews and field trips. As a result of the investigations, it was determined that several large energy users in the State are potential markets for solid waste energy. Figure 1 identifies the users with the most poential in this region.

As a practical matter, metals are the only secondary materials which can presently be recovered and marketed effectively from a resource recovery facility. Scrap dealers and brokers located both in Montana and nationally have indicated an interest in purchasing these materials.



LEGEND

(8) DISTRICT NUMBER

◇1 MONTANA STATE UNIVERSITY

◇2 IDEAL BASIC INDUSTRIES

◇3 KAISER CEMENT & GYPSUM CO.

◇4 STAUFFER CHEMICAL CO.

◇5 THE ANACONDA CO.

◇6 THE ANACONDA CO.

POTENTIAL ENERGY MARKETS FOR REGION NO. IV

FIGURE I

3. Disposal and Materials Recovery Technology

Through in-depth investigations relative to: (1) the existing solid waste management system in the State of Montana; (2) the identification of potential energy users in the State which may be able to utilize processed solid waste as an energy source; and (3) the evaluation of current solid waste processing and disposal technologies; it was determined that several solid waste disposal and utilization alternatives are potentially applicable in the State. Those alternatives are: (1) the direct disposal of solid waste; (2) the transfer of solid waste; (3) solid waste processing, and (4) the utilization of the energy and material resources in solid waste. Summarized in the following paragraphs is a brief description of these alternatives.

The direct disposal of solid waste involves the controlled disposal of refuse in a sanitary landfill without creating air, land or water pollution nuisances, or hazards to public health. In a properly operated sanitary landfill, engineering techniques are employed to confine the refuse to the smallest practical volume after which it is covered with a four to six inch layer of earth at the conclusion of each day's operation, or at more frequent intervals as may be necessary. Presently, the sanitary landfill is the most extensively used method of solid waste diposal in Montana.

The second alternative was the use of transfer stations. Although there are many variations in the design of transfer stations, the basic philosophy is the same: by consolidating waste from smaller vehicles (primary haulers) to larger tractor-trailer units or roll-off containers (secondary haulers), transportation cost is reduced. The basic concept of transferring solid waste from a relatively small payload route-collection vehicle to a bulk hauler has been practiced for several decades in the United States.

The third basic alternative involves the processing of solid waste. The primary purpose of processing is to accomplish some level of materials separation and waste preparation such that the product can be utilized. A secondary purpose for processing is to obtain a material which is more homogenous and therefore much easier to transport and/or dispose of. The degree of processing required is dictated by the demand and market for the recoverable materials found in the solid waste stream, and by the ultimate use of the processed waste. For this project, three degrees of processing were analyzed. They vary from a preliminary processing mode where the solid waste is shredded and the ferrous metals removed, to a highly sophisticated process where the waste is shredded twice, air classified and the recovery of ferrous, aluminum, other non-metals and glass is achieved utilizing magnetic separators, trommel screens and other separation equipment.

The fourth alternative involves the actual utilization of processed solid waste. Four utilization alternatives were investigated for potential applicability in the State; (1) the utilization of processed solid waste as a primary fuel to produce steam for heating and/or cooling purposes, with the option to generate electricity; (2) the utilization of processed solid waste as a supplemental fuel in a suspension-fired boiler to produce steam and/or electricity; (3) the utilization of processed solid waste as a feedstock in a pyrolysis unit to produce a low Btu gas which can be substituted for natural gas; and (4) the utilization of processed solid waste as a soil conditioner.

C. SUMMARY OF ALTERNATIVES INVESTIGATED

A review of the information reported in the three major reports which have been published in conjunction with this project indicated that four of the alternatives which were investigated have applicability in the State. Based on these conclusions, the following four alternatives were analyzed for specific situations in the State:

1. The use of sanitary landfills serving one or several communities and/or jurisdictions.

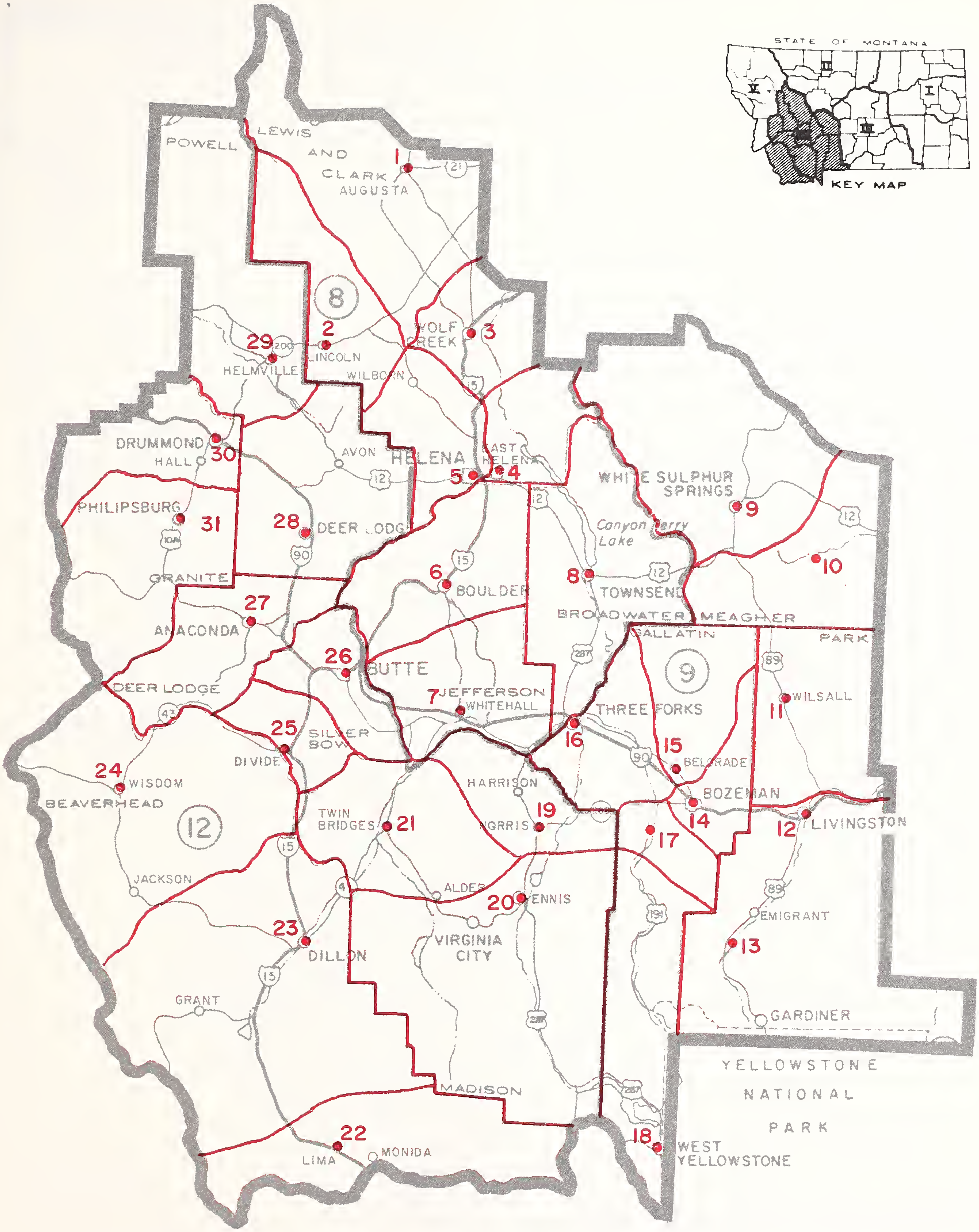
2. The use of transfer stations to economically consolidate and transport small quantities of waste.

3. The use of solid waste as a primary fuel to produce steam.

4. The use of solid waste as a supplemental fuel in an existing solid fuel boiler.

To analyze the various alternatives which were investigated, each State planning region was divided into waste generation zones. The zone locations were determined by grouping census tracts within counties. An attempt was made to group census tracts which had similar population densities and geographical location. Where populations are very sparse, a waste generation zone included an entire county. Where populations are dense, counties were grouped into several waste generation zones. A centroid was also determined according to the population density within each zone. The location of each waste generation zone in the region and corresponding centroid is shown in Figure 2.

To analyze the economics of various solid waste alternatives for a given area, a net system cost was determined for each alternative. The net system cost includes: (1) transportation costs, (2) processing costs and revenues associated with the sale of recoverable materials (when applicable), and (3) disposal costs. Figure 3 illustrates how these factors interrelate for the various solid waste systems which may have application in the State. Listed below is a brief description of each category.



LEGEND

22 ZONE NUMBER

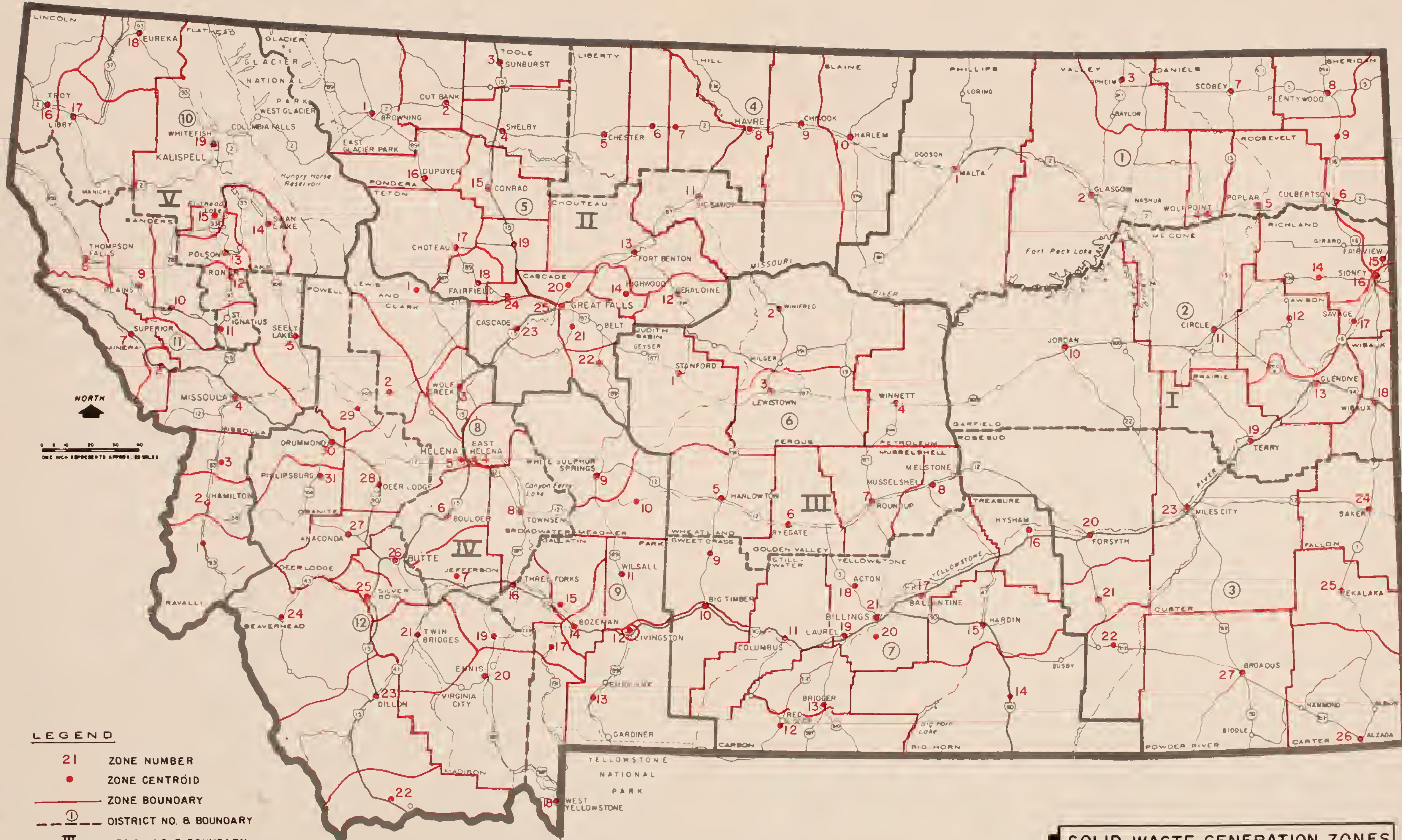
● ZONE CENTROID

ZONE BOUNDARY

(8) DISTRICT NO. & BOUNDRY

REGION IV
SOLID WASTE GENERATION ZONES

FIGURE 2



SOLID WASTE GENERATION ZONES

FIGURE

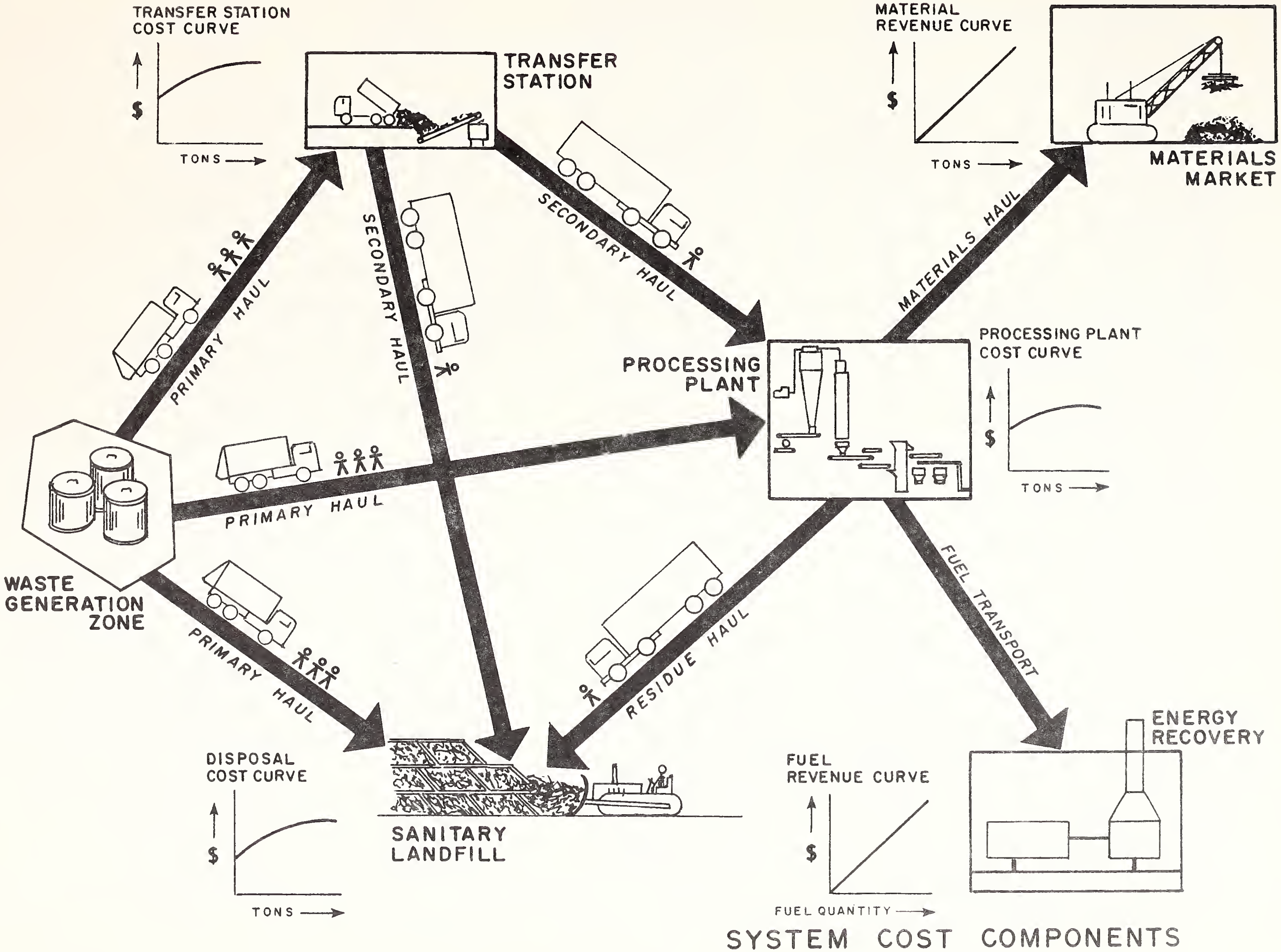

TRANSFER STATION
COST CURVE
$
TONS
TRANSFER
STATION
MATERIAL
REVENUE CURVE
$
TONS
MATERIALS
MARKET
PRIMARY HAUL
SECONDARY HAUL
SECONDARY HAUL
MATERIALS HAUL
PROCESSING
PLANT
PROCESSING PLANT
COST CURVE
$
TONS
PRIMARY HAUL
WASTE
GENERATION
ZONE
PRIMARY HAUL
RESIDUE HAUL
FUEL TRANSPORT
ENERGY
RECOVERY
DISPOSAL
COST CURVE
$
TONS
SANITARY
LANDFILL
FUEL
REVENUE CURVE
$
FUEL QUANTITY
SYSTEM COST COMPONENTS

FIGURE 3

1. Transportation Costs. Transportation costs are separated into two categories: primary haul costs and secondary haul costs. The primary haul costs represent the cost of transporting waste from a waste generation zone, to either a transfer station, processing facility or ultimate disposal facility. Secondary haul costs represent the cost of transporting waste from one facility to another. These costs can be represented by the following types of hauls.

a. From a transfer station to a landfill
b. From a transfer station to a processing plant
c. From a processing plant to a market
d. From a processing plant to a landfill.

As with primary haul costs, secondary haul costs for this project were computed by using transportation network travel times and the factors describing the dollars per ton-hr. cost of operating various type vehicles.

2. Processing Costs and Revenues

For the processing and utilization alternatives, capital costs were estimated and amortized over the projected life of the facility. Operation and maintenance costs were then determined and added to the amortization cost to obtain a total cost per ton for processing and utilization. The potential revenues which could be obtained from the reusable materials were then subtracted from the processing costs to obtain the net cost to operate the processing and utilization facility. This net cost was then included in the overall net system cost of the alternative.

3. Disposal Costs

In most instances, disposal costs consist of landfilling costs. It should be noted that regardless of the degree of processing or resource recovery implemented, a landfill is always necessary for that portion of the waste which cannot be processed or recovered. For each alternative the appropriate disposal cost was included in the net system cost.

D. ANALYSIS OF SYSTEM COST SOLUTIONS

System costs were developed for the major alternatives which are most applicable in the State: (1) the use of sanitary landfills, and (2) the use of solid waste as a fuel source through various processing and utilization techniques. The results of the systemcost analysis of each are summarized herein.

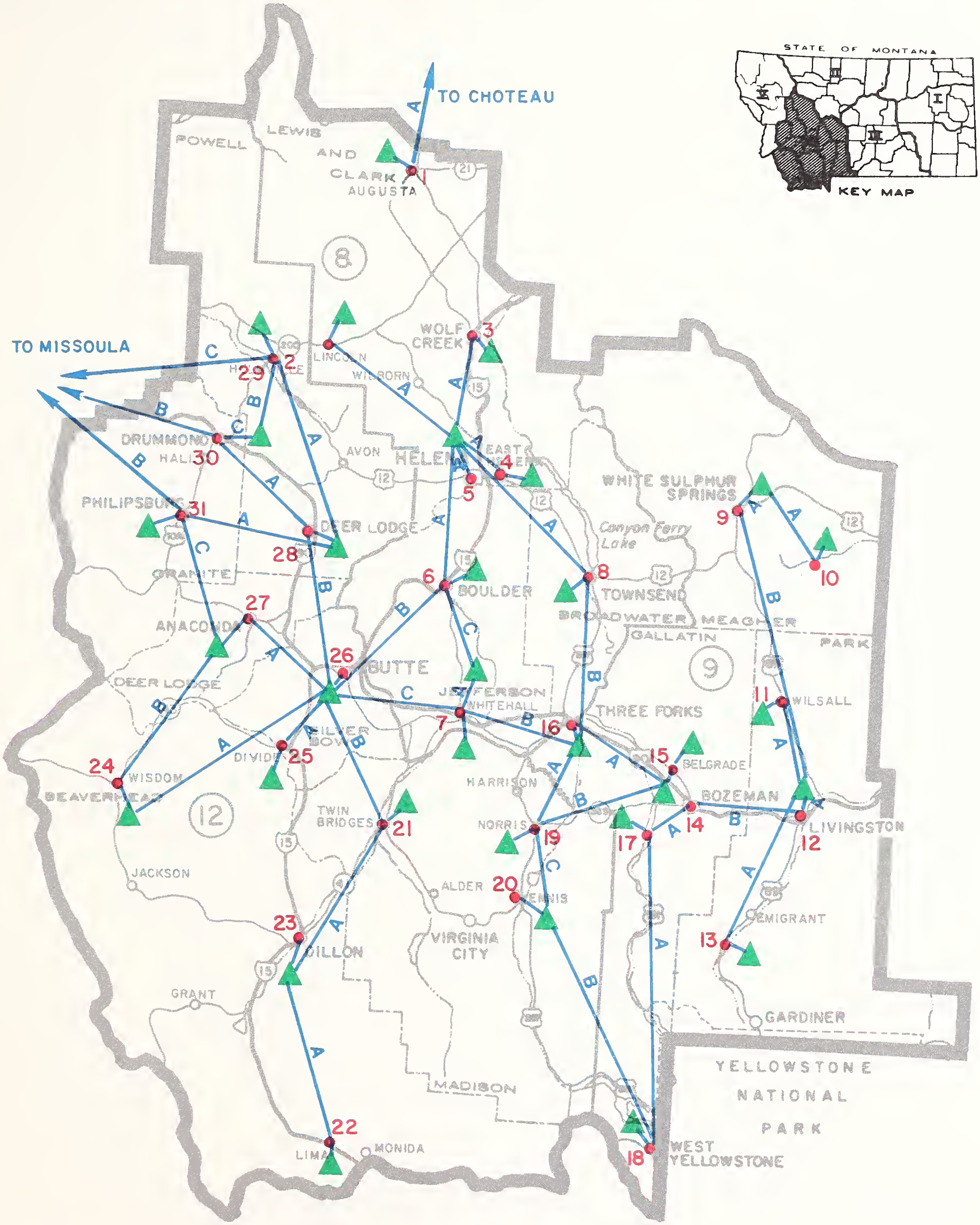
1. <u>Sanitary Landfill Alternative</u>

For this alternative, two basic situations were investigated. The first situation involved the analysis of each waste generation zone operating a sanitary landfill in the proximity of the zone centroid to dispose of all wastes generated in the zone. The second situation involved the analysis of more than one generation zone utilizing a strategically located sanitary landfill (area-wide landfill alternative). For several generation zones, two or three potential area-wide landfill situations were analyzed whereas for other zones only one area-wide landfill situation was determined applicable and evaluated. Figure 4 depicts the various landfill alternatives which were investigated in the region.

Figure 5 summarizes the least cost landfill alternative for each waste generation zone in the region. In many instances, several waste generation zones utilizing an area-wide landfill is the least cost alternative. It was also determined that for several generation zones the cost of utilizing an area-wide landfill is competitive with utilizing a landfill serving only that particular waste generation zone. Local situations for these zones will determine which alternative will best serve the contributing population.

2. <u>Processing and Utilization Alternative (Resource Recovery)</u>

As stated previously, the waste utilization alternatives which have shown the most potential are the use of solid waste as either a primary or secondary fuel to produce steam and/or generate electricity. A detailed analysis of the potential energy markets addressed in the "Energy and Secondary Materials Market Report" revealed that there are seven situations in the State which have potential economical and marketable viability and thus warranted an in-depth system cost analysis. Listed below are these situations. They are grouped according to the type of processing and utilization alternative which have been determined applicable. Because several utilization alternatives include the waste from more than one planning region, the analysis of all resource recovery alternatives in the State are included in this report.

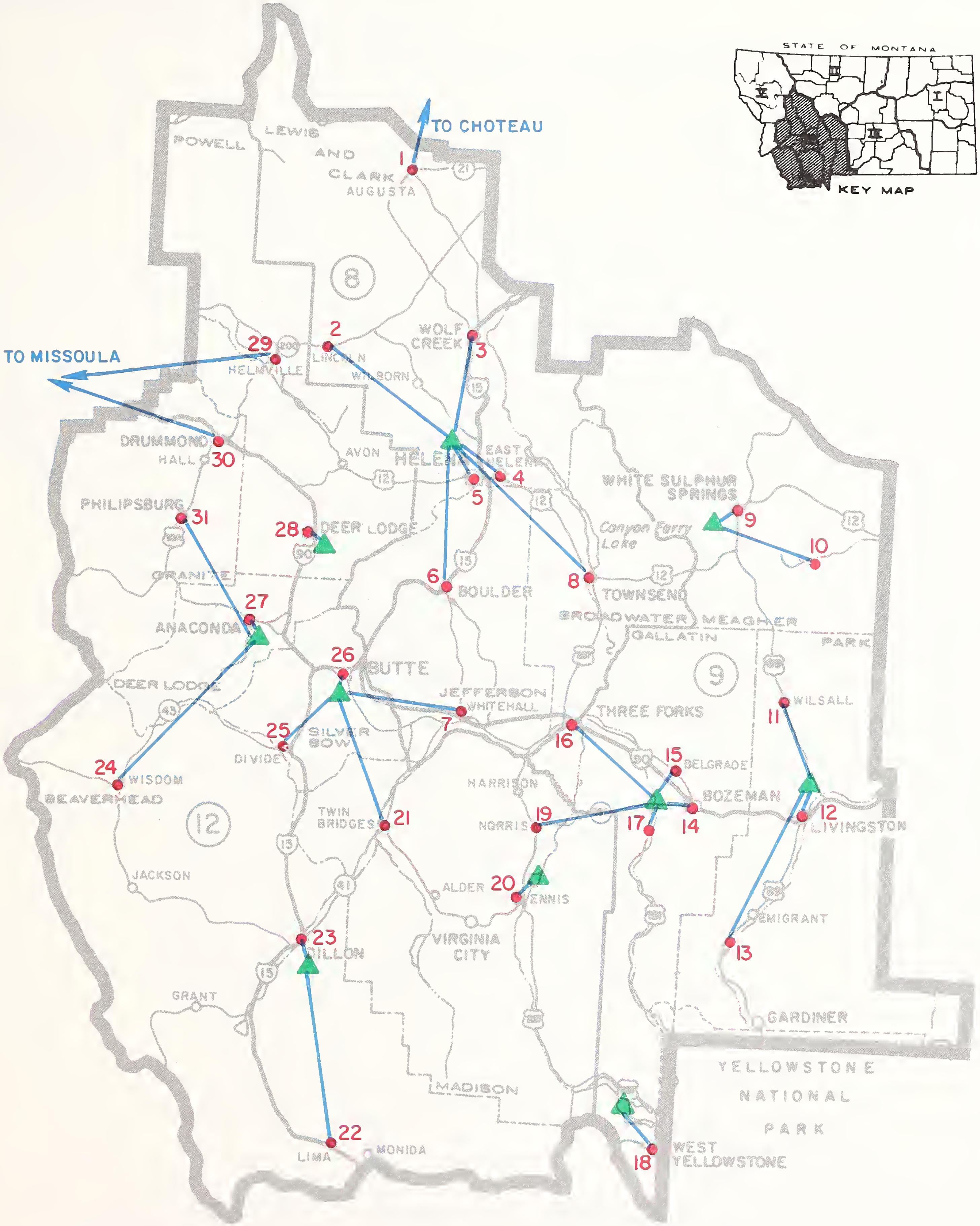


LEGEND

- POTENTIAL AREA WIDE LANDFILL
- A ALTERNATIVES INVESTIGATED
- 22 WASTE GENERATION CENTROID
- (9) DISTRICT NO. & BOUNDRIES

REGION IV
LANDFILL ALTERNATIVES INVESTIGATED

FIGURE 4

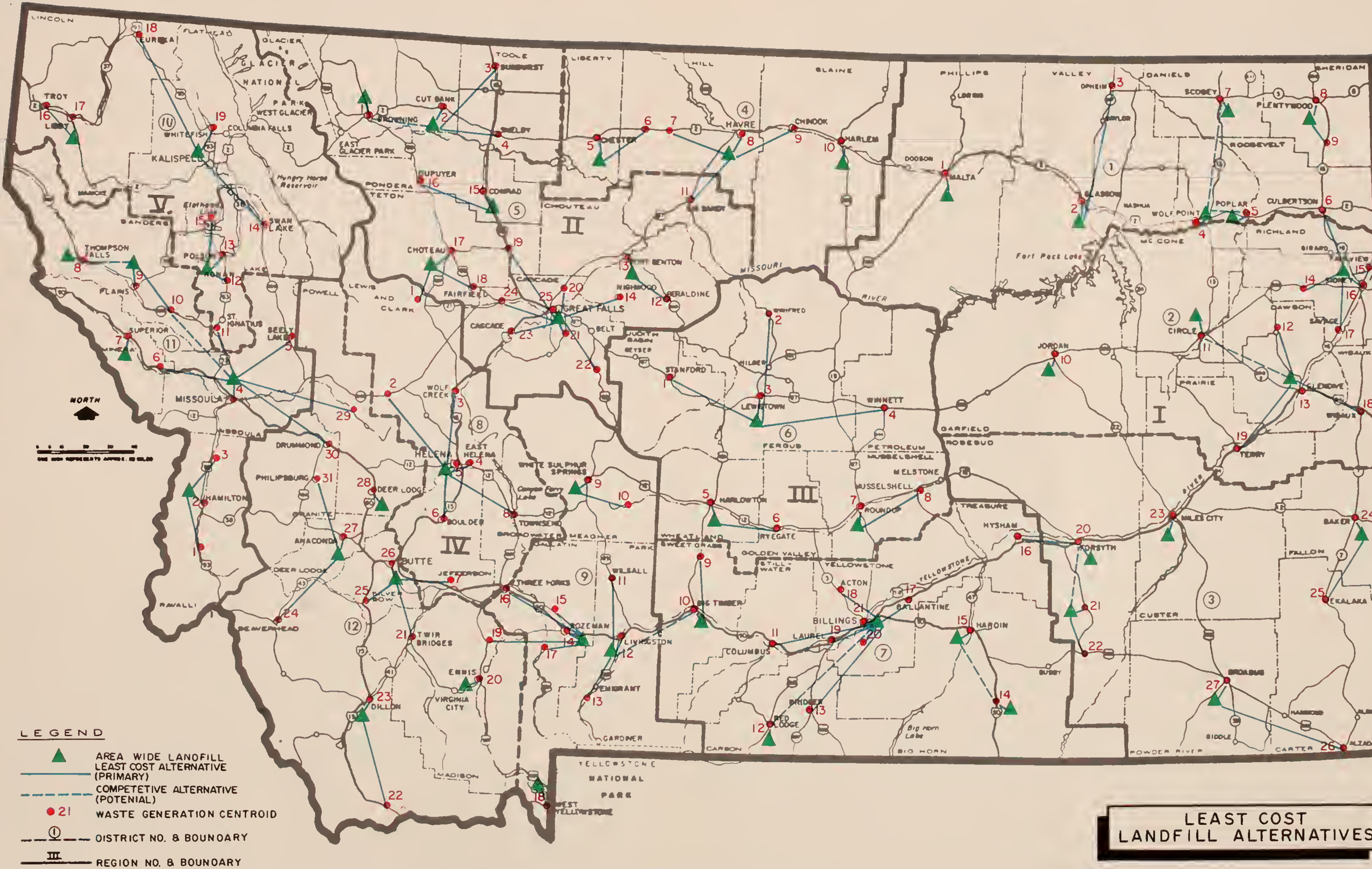


LEGEND

- 22 WASTE GENERATION CENTROID
- POTENTIAL AREA WIDE LANDFILL
- LEAST COST ALTERNATIVE
- COMPETITIVE ALTERNATIVE
- 9 DISTRICT NO. & BOUNDARY

REGION IV
LEAST COST
LANDFILL ALTERNATIVES

FIGURE 5



LEAST COST LANDFILL ALTERNATIVES

FIGURE

a. Steam Generation (Primary Fuel)

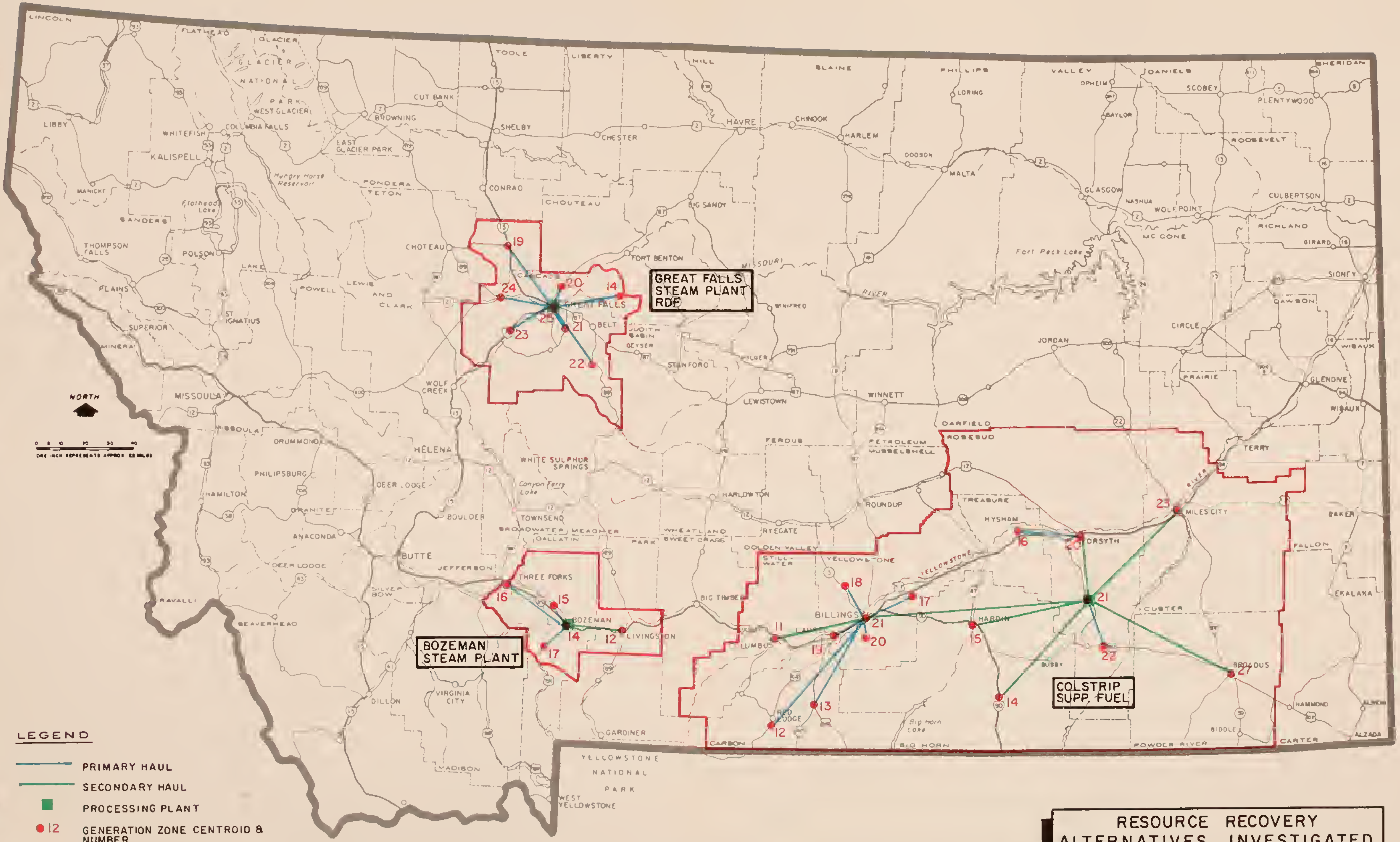
Processing and Utilization Location	Potential Users
Billings	Continental Oil Company Exxon Company USA Cenex Oil Company Cluster of Steam Users
Bozeman	Montana State University
Great Falls	The Anaconda Company
Missoula	Hoerner-Waldorf Corp. University of Montana

b. Supplemental Fuel (Refuse Derived Fuel)

Processing and Utilization Location	Potential Users
Billings	Montana Power Company
Colstrip	Montana Power Company
Sidney	Montana Dakota Utilities

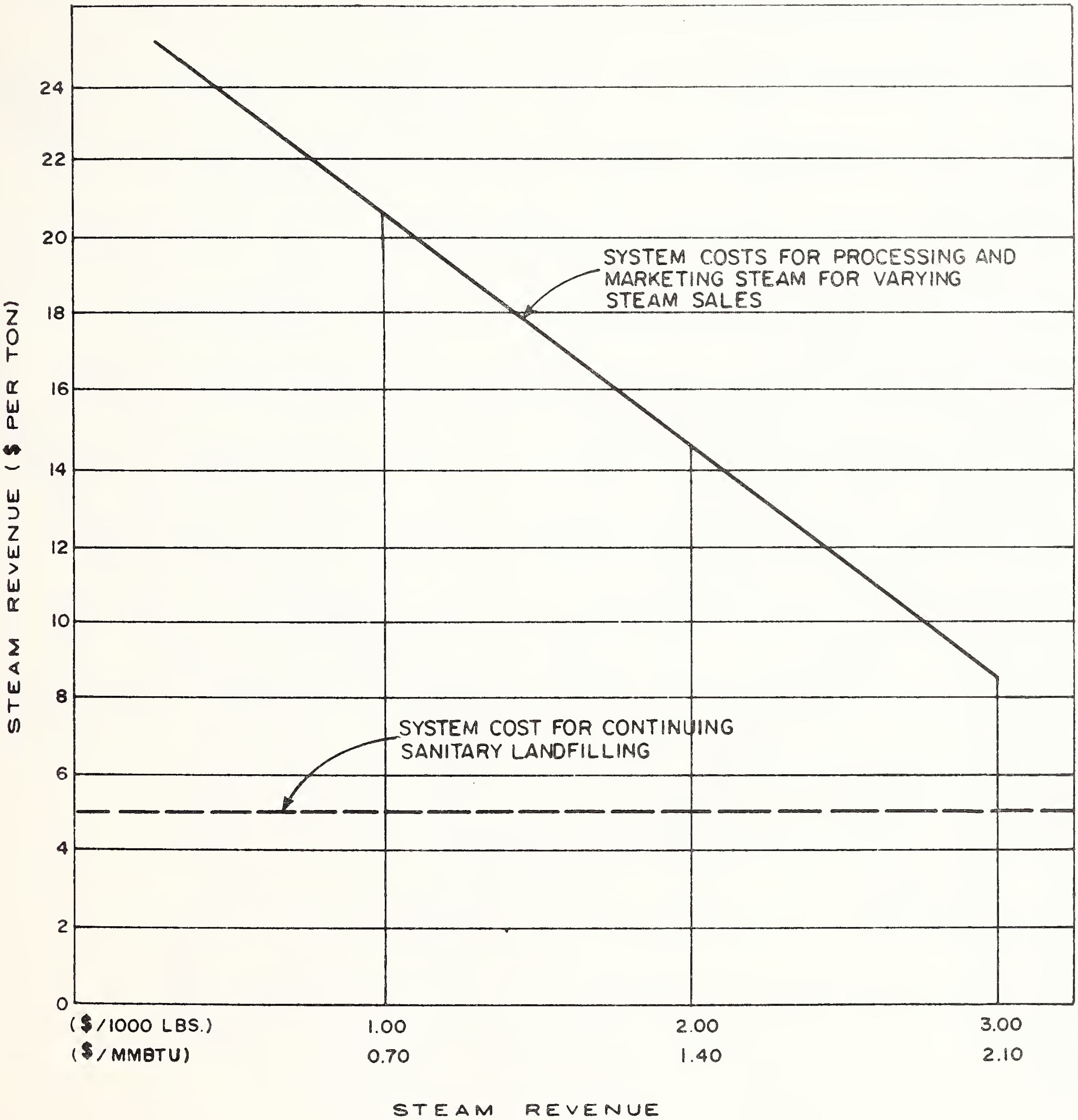
A net system cost was determined for each situation listed above. To determine the system cost, the transportation cost of hauling the wastes from each contributing waste generation zone to the solid waste processing facility was added to the facilities net processing and utilization cost. Figures 6 and 7 show the various alternatives which were investigated and the corresponding contributing waste generation zones. The basis for determining the contributing zones for each alternative were: (1) distance of each waste generation zone to each recovery facility; (2) quantity of waste in each generation zone, and (3) quantity of waste which could be processed and marketed at the resource recovery facility.

For each alternative, the net system cost to utilize the least cost landfill alternative, as shown in Figure 5, was compared to the corresponding resource recovery net system cost. Based on these comparisons, it was determined that the resource recovery alternatives in Billings, Great Falls and Missoula are economically competitive with the least cost landfill alternatives in each respective area. Figure 8 depicts the areas in which resource recovery is economically competitive to sanitary landfilling in the State.



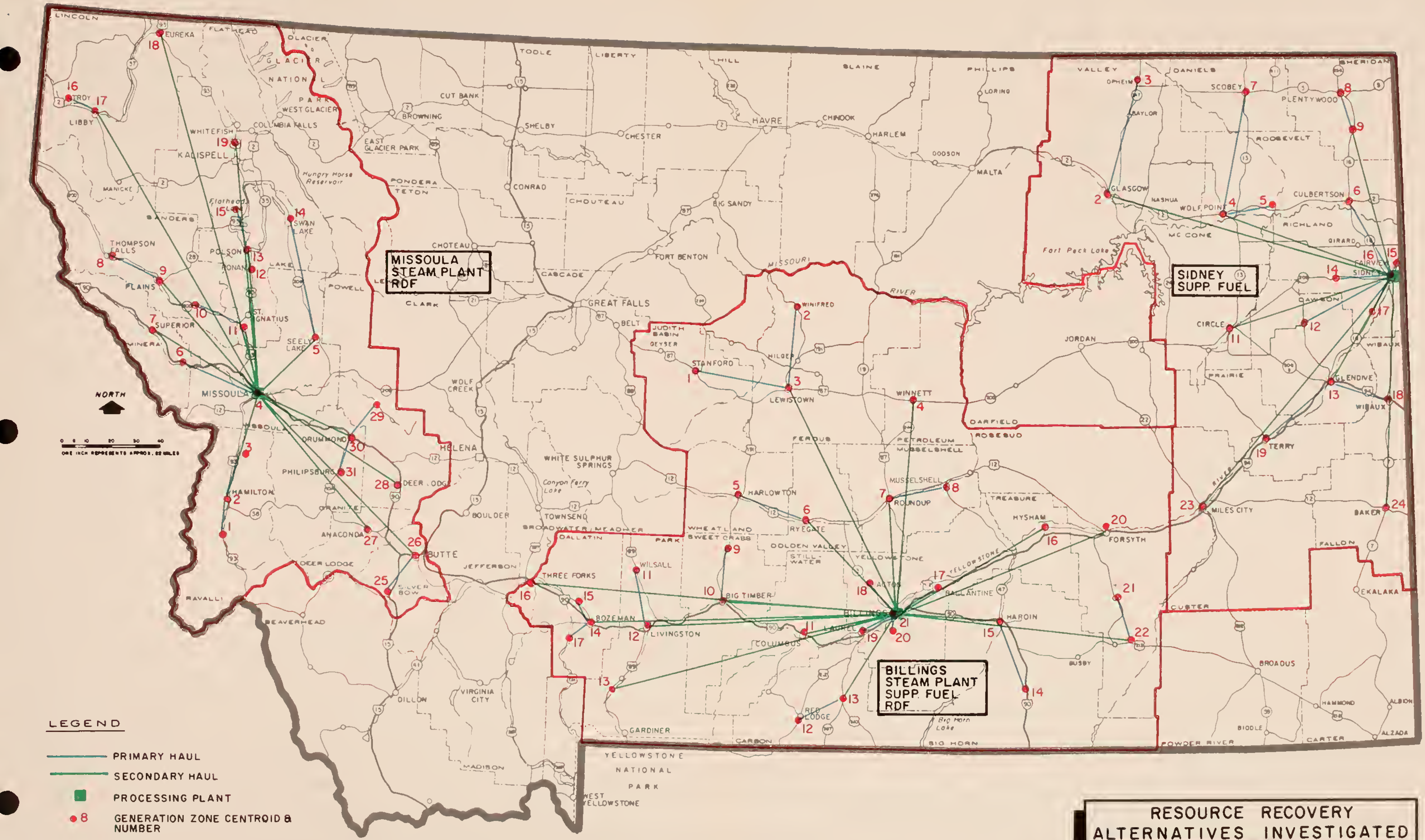
RESOURCE RECOVERY ALTERNATIVES INVESTIGATED

FIGURE 6



NOTE: ALTERNATIVE NO. 1: 143 TPD

SYSTEM COSTS FOR STEAM GENERATION ALTERNATIVE FOR BOZEMAN



RESOURCE RECOVERY ALTERNATIVES INVESTIGATED

FIGURE 7

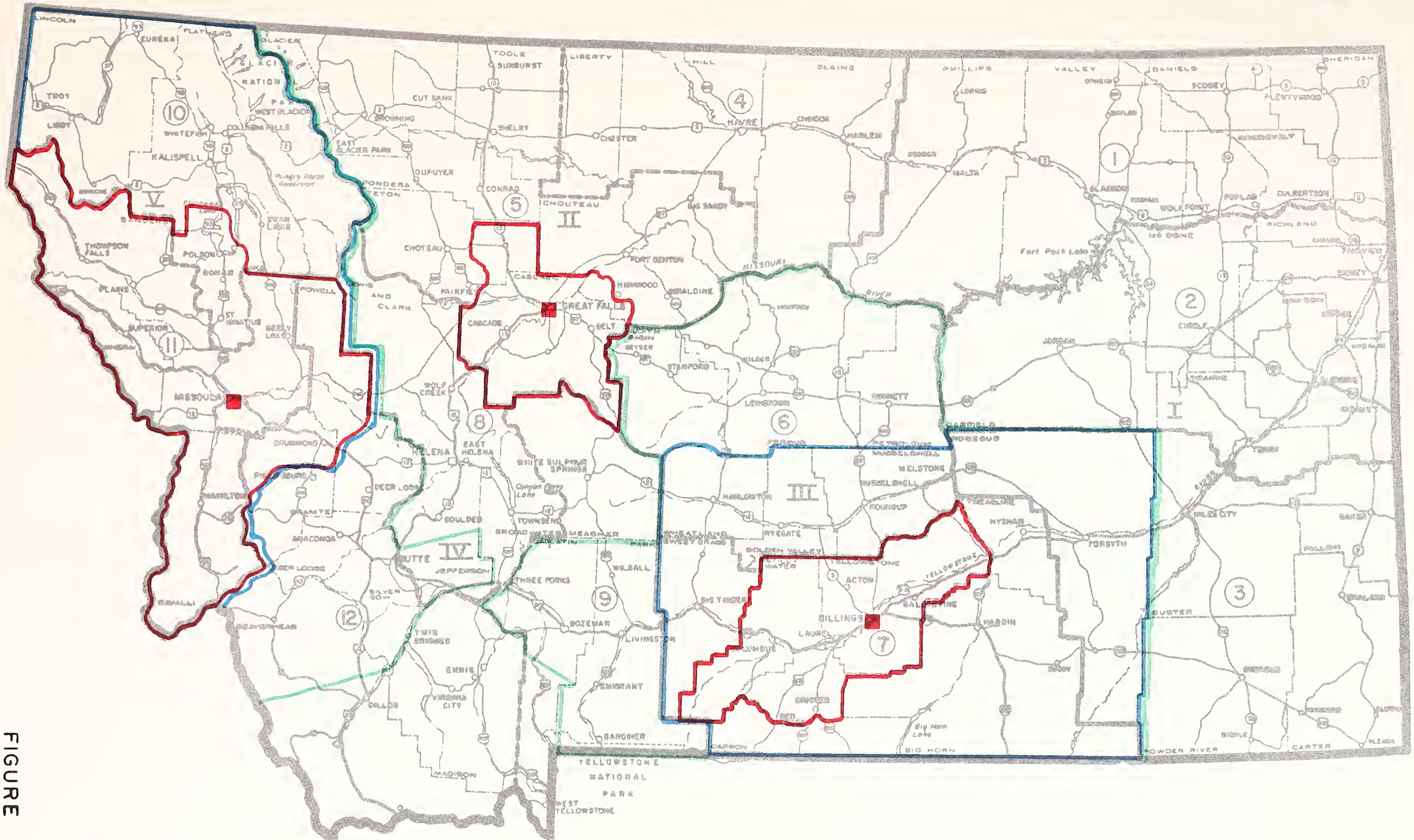


FIGURE 8

LEGEND

SERVICE AREA

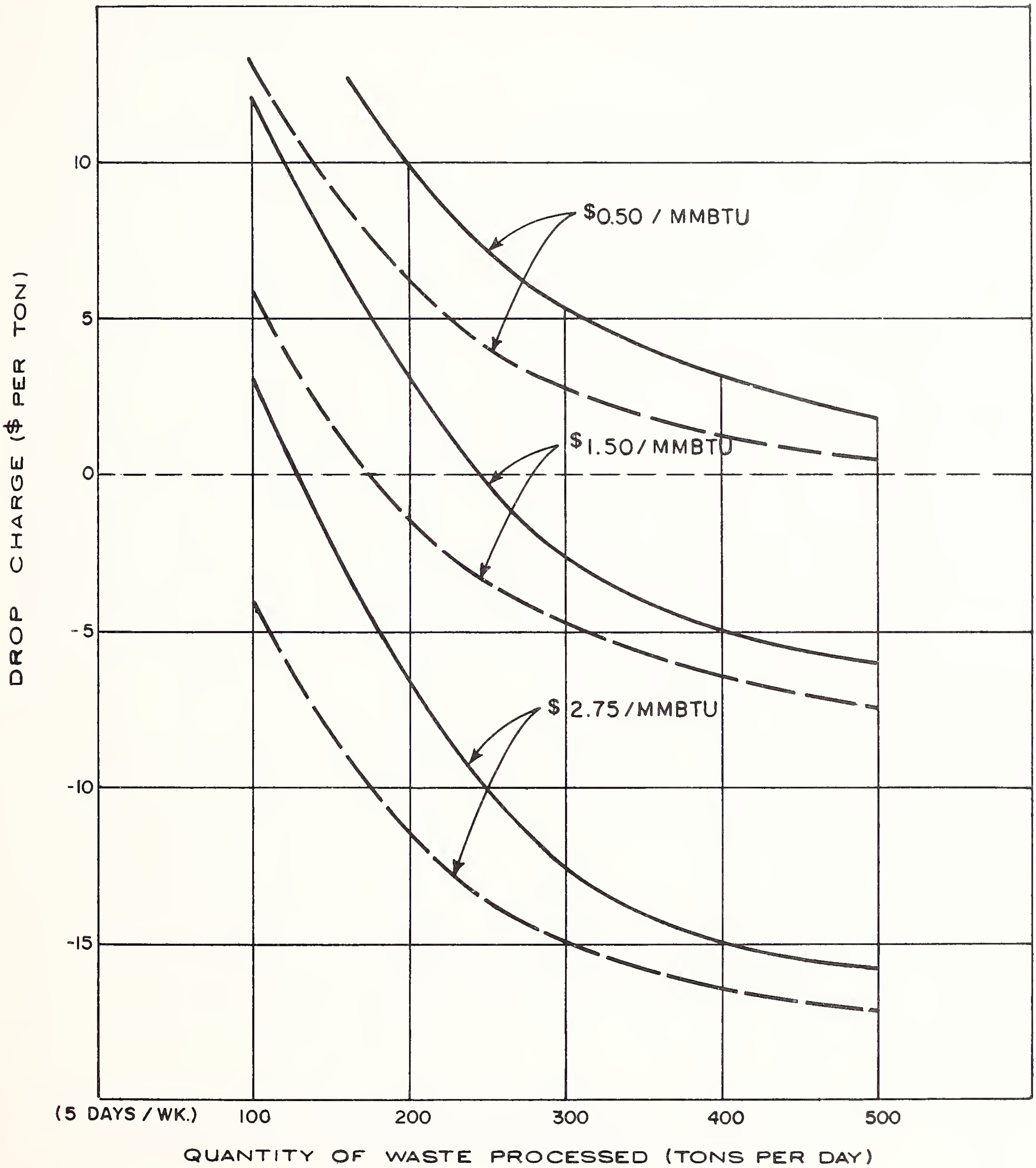
- ALTERNATIVE NO. 1
- ALTERNATIVE NO. 2
- ALTERNATIVE NO. 3
- RECOVERY FACILITY LOCATION

LEAST COST RESOURCE RECOVERY ALTERNATIVES

E. SUMMARY

Based on the analysis of the various alternatives evaluated, it is apparent that the utilization of solid waste as an energy source is potentially viable in Montana. The costs associated with utilizing solid waste as an energy source are competitive with the costs to operate sanitary landfills in three areas: (1) South Central Montana (Billings; (2) Cascade County (Great Falls); and (3) Western Montana (Missoula). For resource recovery to be economically viable in these areas, it will be necessary to utilize a system of transfer stations such that the waste generated in the rural and sparsely populated areas can be economically transported to the various waste processing and utilization facilities.

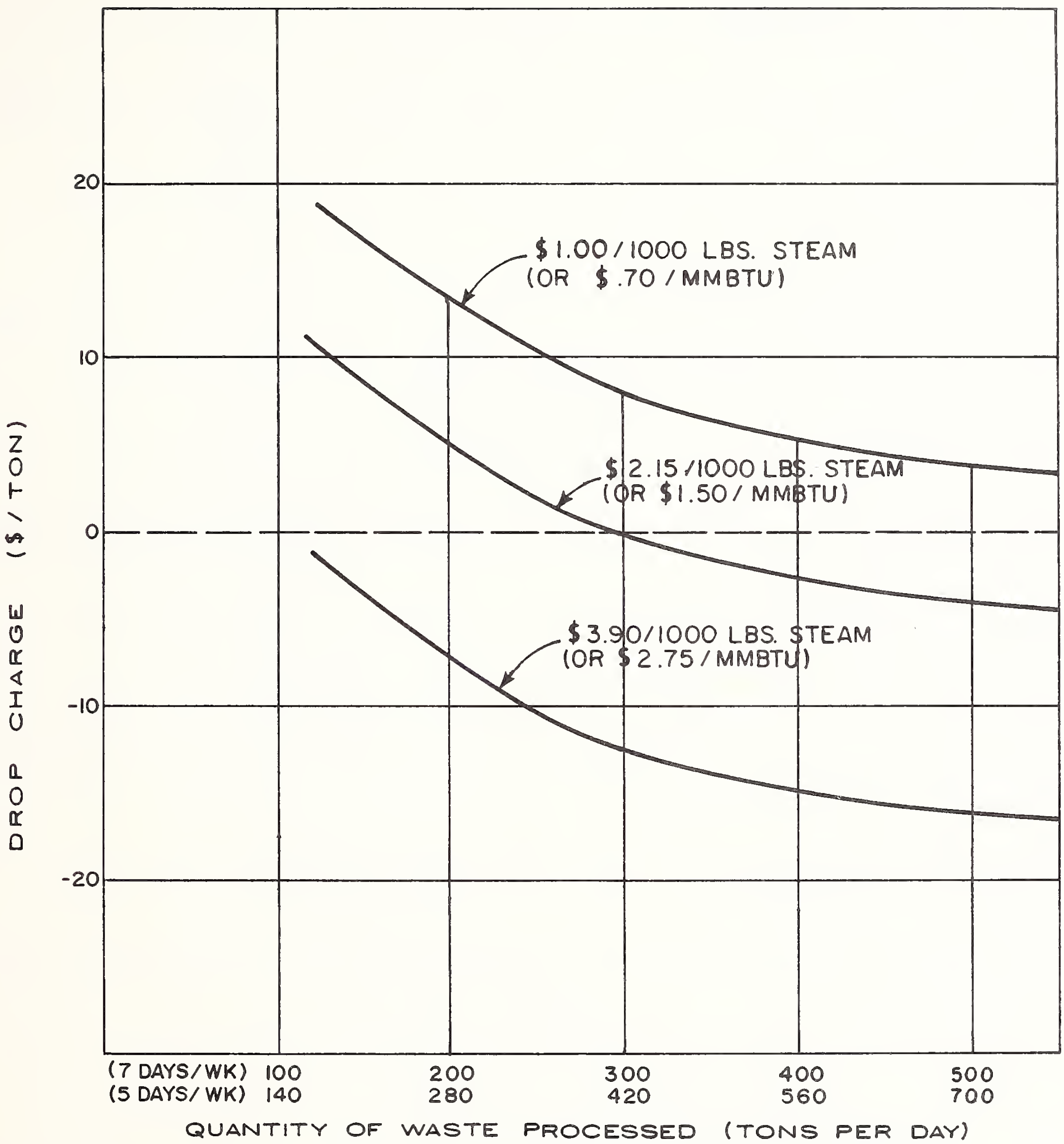
It has also been shown that for areas where resource recovery is not a viable alternative at the present time, the use of area-wide landfills, whereby several cities and communities utilize the same sanitary landfill, is more economical than for each community to operate its own disposal site. The area-wide landfill approach can also be a stepping stone for implementation of future resource recovery projects which may become feasible in future years.



NOTES: Residue Disposal Costs & Metals Revenues Are Included.
Transportation Costs & Boiler Modifications Are Not Included.

LEGEND
——— SUSPENSION FIRED FUEL
– – – – STOKER FIRED FUEL

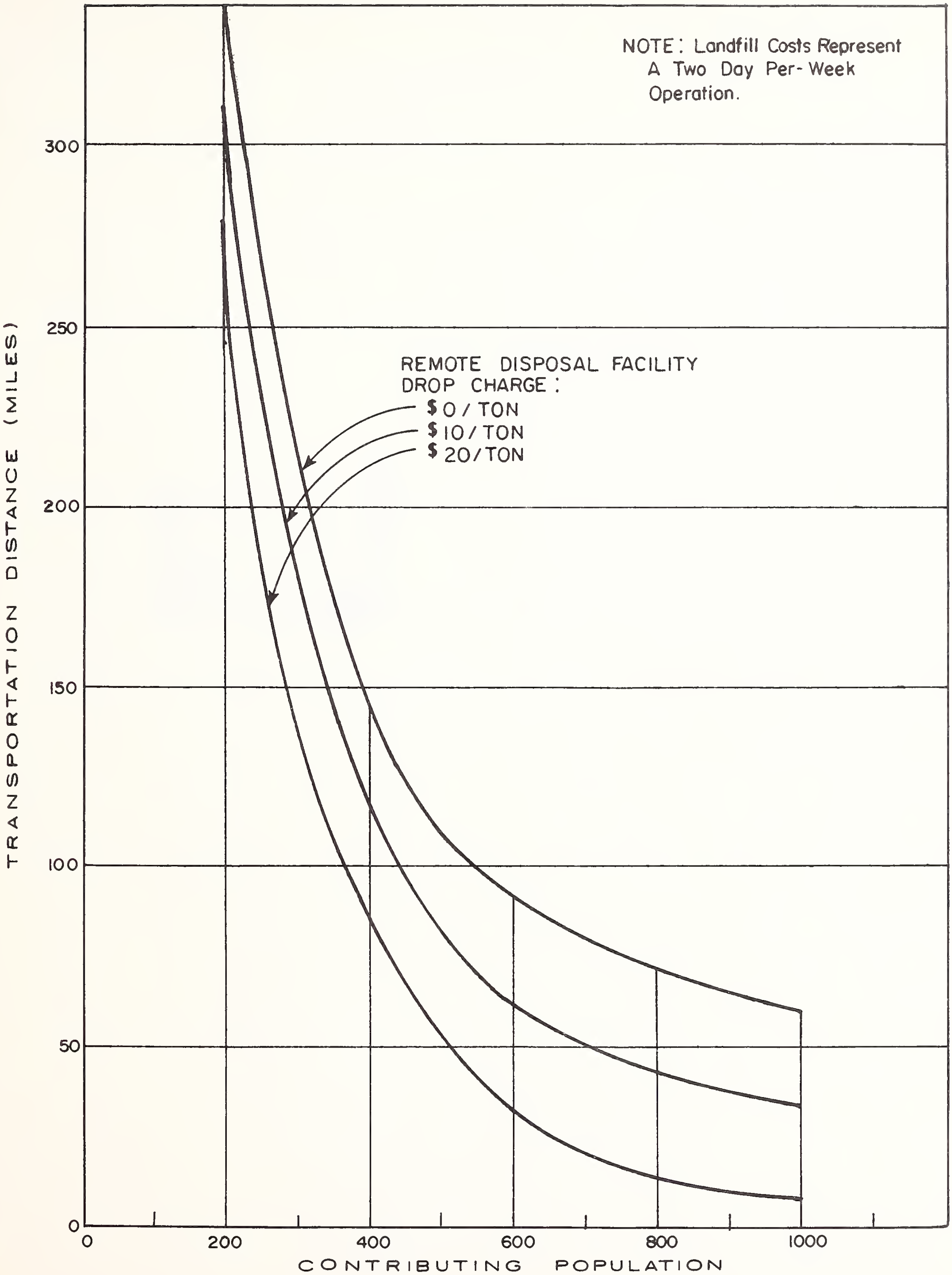
REFUSE DERIVED FUEL PROCESSING ALTERNATIVE SENSITIVITY OF DROP CHARGE TO FUEL REVENUE



NOTES: Residue Disposal Costs & Metal Revenues Are Included.

Transportation & Steam Distribution Costs Are Not Included.

STEAM GENERATION ALTERNATIVE
SENSITIVITY OF DROP CHARGE
TO STEAM REVENUE



COMPARISON OF BREAKEVEN COSTS OF UTILIZING LANDFILL VS. CONTAINER SYSTEM